43. The apparatus of claim 24 further comprising a mixer to combine said first and second signals after said adjusting step.

REMARKS

Claims 1-4, 8-21, 24, 25, 28, 29 and 36-43 are pending in the present application. Claims 5-7, 22-23, 26-27, and 30-35 have been previously canceled. Claims 1, 8, 12, 17-19, and 24 have been amended.

Claim Rejections Under 35 U.S.C. §§ 102(e) and 103(a)

Claims 1, 2, 19, 20, 37, and 41 were rejected under 35 U.S.C. §102(e) as being anticipated by Zoels, US Patent 6,385,323. Claims 1-4, 19-21, 37, and 41 were rejected under 35 U.S.C. §102(e) as being anticipated by Yamada et al, US Patent 6,301,365. Claims 36 and 40 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada et al. Claims 8-11, 24, 25, 28, 29, 38, 39, 42, and 43 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada et al in view of Eastty, US Patent 6,246,773. Claim 12 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ono in view of Eastty.

In response to this rejection, applicants have amended claims to further bring out a feature of the present invention concerning the independent adjustment of the selected frequency bands in relation to other frequency bands of the input signals. Attached to this Amendment is a sheet with two figures (FIG A and FIG B), discussed below, which compare the outputs of an embodiment of the present invention and the system of Yamada. Additionally, claim 12 has been

reverted to its original dependent form (it had been changed to independent in response to a now withdrawn indication that it would be accepted as independent), and claim 18 has been amended to rely upon independent claim 8.

ZOELS

The Zoels abstract describes its basic process as "automatic microphone balancing", and the balancing he describes is the level matching of two omnidirectional mics, done to optimize the signals so that a later phase inversion technique can be more accurately used to convert the outputs of the two omni mics into an output with directional characteristics. Commercial microphones built this way have been for sale for over 50 years. One signal is subtracted from another in Zoels' Difference Element 3.

According to an embodiment of the present invention two specially treated signals are summed to accomplish its result. In Zoels, there is no signal filtering at all, either selective or complementary, discussed or implied. Filters 8a and 8b, mentioned on page 3 of the Office Action, are not frequency domain filters, but are part of a rectifier stage, as described at Zoels, Col. 3 lines 6-10,:

"...Inventively, the output signals of the two amplifier stages 2a and 2b are also supplied to a second difference element 9 via two rectifier stages that are respectively composed of balancing elements 6a, 6b, absolute value-forming units 7a, 7b and filters 8a, 8b. ..."

There is, therefore, no frequency filtering in Zoels. In the presently claimed invention, one or more frequency bands of the first and second signals are selected and level adjustment is performed in those frequency bands. Such selection and adjustment are not taught or suggested in Zoels. The rectification in Zoels is done so that level comparisons can be made between the

two signals, as stated in the next sentence (Zoels Col. 3 lines 10-14):

"... Following the two rectifier stages, which can also be fashioned with digital components, the output signals are subtracted from one another in the second difference element 9 in order to identify any deviation therebetween...."

This filtering is not in the signal path at all, and is there is no motivation for adapting the system in Zoels to start filtering in the audio signal path. Zoels does mention other 'not shown' filters, but these too are only in the control chain comprising second difference element 9:

Col. 2 lines 52-57
"... In order to avoid distortions, it can also be advantageous not to implement any automatic microphone balancing outside of an identifiable frequency range. Thus, for example, the inventive method can be implemented only in a specific frequency range on the basis of a bandpass filter. ..."

Col. 3 lines 34-38 (this is the filter alluded to in the above quote from Col. 2 lines 52-57):
"... Via a filter element (not shown), an adjustable frequency range of the output signals of the amplifier stages 2a and 2b is supplied to the second difference element 9, so that, for example, especially high or especially low frequencies can be blanked out. An undesired distortion that can occur given automatic microphone balancing in these limit frequency ranges is thus avoided. ..."

Col. 3 lines 50-54
"... A filter element (not shown) and the level acquisition element 12 can be connected in common with the second difference element 9 and the analysis/control units 10 and/or 11 in order to achieve a corresponding overall balancing (not shown) of the automatic microphone balancing. ..."

Though band pass filters are discussed in Zoels, there is no suggestion or teaching in Zoels to increase the level of a frequency band in one signal with a resulting decrease in level of a frequency band in another signal as recited in the claims.

YAMADA

Attached is a sheet with two figures, FIG. A and FIG. B. The figures compare the outputs of a system according to an embodiment of the present invention and that of Yamada. FIG. A shows a sample output of the 1st processor (see Fig. 2 of the present application) and Yamada's FIG.1 #15. FIG. B shows the outputs of the 2nd processor of this system and Yamada's FIG.1 #16. In both systems, two outputs may be changed in response to the manipulation of a single control, for example FIG.1 #17 of Yamada and FIG. 2A #13 "g" in the current application. The single control thus effects the changes seen in both of the attached figures.

The dashed lines (one in each figure) represent the outputs of both systems when the controls of each are set to produce arbitrarily chosen but identical outputs. Starting from this arbitrary point, the control FIG.1 #17 of Yamada and the control FIG. 2A #13 "g" of the present application are both moved so that an identical change in level occurs in the frequency band selected for equalization. The changes in level are noted on the figures as the reduction -ΔL of FIG A, and the corresponding identical increase +ΔL of FIG B.

In both figures, the solid line represents the output of an embodiment of the present invention, and the dash&dot line represents the output of Yamada. Note that, although the response of both systems is identical in the region selected for equalization, the outputs differ by ΔL in the rest of the frequency spectrum, except for a gradual change from 0 to ΔL in the transition regions. Thus, according to an embodiment of the present invention, a single control can change the amount of equalization applied to selected frequency bands in the two signals, but Yamada does not. Yamada only allows for a simultaneous change in the ENTIRE frequency

range of the two outputs, so that an advantage of the presently claimed invention's ability to modify a pair of selected frequency bands is lost. Claims 1, 8, 19, and 24 have been amended to bring out this feature of the present invention.

Furthermore, the system of Yamada cannot be adapted to accomplish the results of the presently claimed invention. Additionally, there is no incentive to adapt or modify Yamada to accomplish such features, as Yamada explicitly teaches his invention is directed to sources of material that are clearly unrelated, and only reproductive in nature ("reproducing apparatuses") at Col.7 lines 23-30:

"Also, while the foregoing embodiment has been described in connection with CD players as apparatuses for reproducing recording signals on recording media, it is apparent that the present invention is not limited to this particular reproducing apparatus but may be applied to mixers using other reproducing apparatuses such as a tape deck, a mini-disc player, or the like."

Thus, in the field of Yamada, there is no motivation to consider the method of the present invention, as it has no advantage or obvious use for any of the circumstances Yamada describes or alludes to.

An important feature of one embodiment of the present invention is the ability to select frequency bands in two signals from the same source material, and another important feature is to simplify the task of creating inverse-related versions of the two signals. An example of the present invention for accomplishing this is by a unique arrangement of filter elements. In the system of Yamada, the only equalizers or filters mentioned at all are those designated in Fig. 1 as 21-24, as described in Col. 2 lines 63-66:

"...The equalizer adjuster 21-24 adjust the frequency characteristics of audio signals respectively supplied thereto from the associated input level adjusters 11-14 in response to manipulations of the operator;..."

This is simply a statement that some sort of standard hand operated tone control can be included in a Yamada embodiment. There is no mention of how to use these, and the implication is that they function as standard tone controls for each CD player, with no purpose any more particular than the way tone controls are designated for use on a clock radio or boom box or any other audio device with unspecified 'tone controls'. These are also clearly not part of Yamada's system.

Regarding the comments on page 4 of the Office Action:
"Claims 36 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamada et al. Yamada et al do not disclose that the frequency selections are the same in channels one and two using the equalizers 21 and 22. However, it would have been obvious to one of ordinary skill in the art at the time of invention to choose the same frequency band. Since the equalizers are manually adjustable, there existed the possibility to use the same frequency band for the two channels. One would have been motivated to use the same band for the purpose of ensuring that the cross fading of the input signals didn't have any unwanted signals being reproduced. The cross fading manipulation would not have been effective if different frequency bands were chosen. Some of the signals that were to be decreased in amplitude and faded out would not be decreased at all if they were not chosen."

The cross fading manipulation of Yamada is designed specifically and only to turn off one input while turning on another. It is designed to gradually but entirely eliminate one signal while gradually adding a different signal. In the circumstances of Yamada, no one expects, or ever expected, one disco or techno dance song to somehow 'sound like the other'. There is no reason to use the equalizers for any purpose other than that of 'taste', which varies completely with the way each song sounds (hence, an eq on each cd player). The statement that "[t]he cross fading manipulation would not have been effective if different frequency bands were chosen" is not in the spirit of the field of invention for Yamada; Yamada's device is successful if it turns

down one input and turns up the other, regardless of any adjustments to the equalizer adjusters 21-24.

On page 5, the Office Action states:

"The mixer provides a crossfading operation so that one signal is decreased while the other signal is increased. The wanted signal is amplified, while the unwanted signal is attenuated."

In Yamada, one signal is wanted until, essentially, the song is over, and then the next signal (the next song) is wanted, followed by the next signal (the third song), and so on. Applicants find the use of the phrases 'wanted signal' and 'unwanted signal', rather than (e.g.) the terms 'first song' and 'second song', to be inaccurate under these circumstances, and offer this reconstructed version of the examiner's sentence to make the point:

The mixer provides a crossfading operation so that one signal is decreased while the other signal is increased. The [wanted signal] second song is amplified, while the [unwanted signal] first song is attenuated.

EASTTY

Eastty fails to make up for the deficiencies of Yamada. The basis of the system of Eastty is to time-correlate two signals with similar content, in order to allow the increase or decrease of that similar content by then adding or subtracting a desired amount of one of the signals to the other. Eastty accomplishes this by using a 'training adaptive filter' FIG. 4 #4 to examine the two signals, find correlations, and use the correlations as a basis for a delay of whichever signal arrived first, so that the common signal components are simultaneous. This avoids the comb

filtering often experienced with signals of slight delay. User adjustments of any frequency bands in Eastty are likely to UNDO the effectiveness of the adaptive adjustments by introducing phase differences, and therefore DEGRADE the performance of Eastty. Furthermore, Eastty's method specifically avoids filtering the primary signal content; Eastty uses two signal sources to *avoid* filtering the primary signal content. Accordingly, as with Yamada, Eastty fails to teach or suggest the selection and adjustment of level of frequency bands in first and second signals as recited in the pending claims. Therefore it would not be obvious to use Yamada to improve or modify noise cancellation by Eastty.

A major difference between the presently claimed invention and Eastty is that Eastty will remove noise best only when the undesired noise is similar in both microphones, and particularly prominent in the 2nd microphone F (FIG 4 #2), as it needs an isolated version of the signal to be added or subtracted in order to perform the correlation. The presently claimed invention may work best when the undesired noise is significantly LESS in the 2nd microphone, so that an isolated frequency-band of relatively noise-free sound can be added to that of the first microphone, which has had a frequency-band of relatively noise-filled sound removed from it. In short, when reducing noise, the system of Eastty favors a situation where the 2nd micreceives much noise and little signal, while some embodiments of the presently claimed invention favor the situation where the 2nd mic receives little noise and much signal.

Eastty filters only one signal (the noise signal), and does so over the entire frequency range of its correlation with the other signal, whereas the presently claimed invention filters both

signals only in the selected frequency bands. Eastty cannot be adapted to add one thing and subtract another from two different signals as in the presently claimed invention, which may have a variety of uses unrelated to those accomplished by Eastty. In one embodiment, this processing of signals may be easily accomplished using analog circuits, and would not be dependent upon operations restricted to digital processing, as is Eastty (COL. 2 Lines 41-44):

"All embodiments of the invention described herein operate on digital audio signals. It is assumed that the microphones 1 and 2 referred to herein include analogue to digital converters."

Among other things, the use of digital processing induces a delay, which makes it less desirable or even unsuitable for circumstances (e.g., in live performance) where the delay can be noticeable and disruptive. From Eastty Column. 2 Lines 34-36:

"The product is integrated over time by an integrator (i.sub.n) comprising an adder+and a delay stage z.sup.-1 (as indicated at i.sub.n for one stage), to form a coefficient..."

This delay can be minimized by using expensive, fast digital processors, but no matter how fast they are, the delay has to at least equal the time difference between the first and second microphone signals, since the earlier of the signals must be delayed until its match arrives (one can not make the later signal arrive 'earlier' in real time processing, you can only delay the earlier signal to arrive later).

Note that the embodiment of Eastty can be fooled by complicated circumstances. For example, George Anteil's "Ballet Mécanique" includes a fan A as part of the instruments in the orchestra, played (turned on) at times during the piece as a 'wind sound' component of the music. If the second microphone of Eastty were to be placed near an unrelated and offending cooling fan B at the rear of the concert hall, the adaptive filters would try to use the sound of B to try to extract from the first microphone a B prime component, but would likely have great difficulty

distinguishing the A from the B prime, and would thus not come up with an accurate delay signal to cancel the noise with. Also, for a more normal circumstance with a regular music piece at microphone 1 and (e.g.) air-conditioning noise at mic 2, the Eastty device would be confused when the air-conditioner turned off, and could then start to correlate and subtract the remainng music signal at mic 2 from the music signal at mic 1. One solution for this would be to add a gate to mute the effect of Eastty when the signal at mic 2 drops below a certain level (below the level of the air-conditioner noise), but this requires someone to set the gate, additional equipment, etc.

On page 5, the examiner states: "It would have been obvious to utilize the noise cancellation arrangement of Eastty to supply the mixer of Yamada et al with musical instrument signals for the purpose of canceling interfering noise signals during musical instrument sound reproduction."

Applicants note that the invention of Eastty accomplishes the noise reduction described without any need for any further mixing of signals, but requires the noise in both microphones 1 and 2 to be the same, which is never the case in the field of Yamada. In Yamada, where the signal sources are completely different, there is no point or need for any noise canceling, as there is in fact no common noise source (as described above). Adapting Yamada to Eastty would not accomplish any improvement in noise cancellation, and there is no incentive to adapt Eastty to Yamada because there is no common signal and therefore no common signal delay to be corrected.

On pages 5-6, the Office Action states: "The modification of Yamada et al would have provided the one input channel with the unwanted noise signal and another input channel with the wanted musical instrument signal mixed with the noise. The mixer could have then been manipulated to decrease the noise signal amplitude while increasing the instrument signal amplitude, effectively canceling the noise. Advantages of using the Yamada et al mixer in

conjunction with Eastty supplied signals included giving the user the capability of selecting the frequency band of the signals to be processed and increasing the functionality of the mixer to include noise cancellation."

Applicants note that the basic point of Eastty's noise canceling embodiment is to correlate and determine <u>both the optimum level and delay</u> from one of the signals in relation to the other so as to do the best job of reducing the noise (Column 4, lines 25-28, applicant's emphasis): "The filtered signals A and B are compared in the comparator 831 to produce the error signal ε which <u>is supplied by a gain and phase adjustment circuit</u> to 832 to the coefficient generator. The adjustment circuit is provided to ensure stable operation of the filter."

As noted above, any modifications to this will undo the adaptive filtering and thus decrease the effectiveness of the noise reduction, so there is no point to using two of Yamada's channels to control the signals going into Eastty. Also, the result of Eastty is a single signal, and could not then be applied to two of the channels of Yamada.

On page 6, the Office Action states: "As to claims 10 and 25, the use of any type of instrument would have been obvious, since they all are susceptible to noise. The placement of the microphones would have been by experimentation for optimal noise cancellation. An artisan of ordinary skill in the art would have been able to locate the microphones in the best position without undue experimentation. Regarding claim 11, the level adjusting gain ratio would have been an obvious design choice."

Claims 10 and 25 of the present invention describe a specific adaptation of the invention to a unique situation where one loud musical device (a hi-hat) is within inches of a second loud musical device (a snare drum). The statement "...the use of any type of instrument would have been obvious, since they all are susceptible to noise..." mis-characterizes the nature of these claims, as the use of the word 'noise' is not in character with the situation, which is discussed in

the body of the present application on pages 13-15, starting with the sentence: "The method suggests that exceptional benefits may be derived by constructing special devices for specific situations."

Regarding the statement "An artisan of ordinary skill in the art would have been able to locate the microphones in the best position without undue experimentation. Regarding claim 11, the level adjusting gain ratio would have been an obvious design choice ...":

The just mentioned section of the application describes a situation where experimenting with different microphone placements results in a variety of responses, each of which is a poor choice for use, and how it is only through the addition of an embodiment of the present invention that a suitable solution is found. After the process of considering a variety of mic positions which are alone failures, and then noticing an improvement by applying the methods of the present invention, it was noticed that yet another variable was causing problems and needed to be solved. This was to find the correct balance for the levels of the two mics, which needed to be done in a way that produced not only a significant reduction in the crosstalk from the hi-hat, but that also produced a final combined sound that is essentially indistinguishable from the desired sound of the snare drum as produced by the properly placed first mic alone. Recognizing this as a variable in the equation was only possible after the first partial solution to the problem was determined by applying the methods of the present invention to the specific situation. Accomplishing a solution for the new variable required the applicants to test a large variety of circuit and design parameters with a large variety and number of instruments (snare drums and hi-hats) until all the parameters were found for a simple embodiment that will work with any snare drum and any hi-hat. Applicants respectfully disagree that these are obvious design choices.

On page 6, the Office Action states: "Per claims 28 and 29, it would have been obvious at the time of invention to use an acoustic pressure microphone for the first signal source (the wanted signal) since it emanates from the musical instrument and is best served, as one of ordinary skill in the art would have know. The type of microphone for the second signal source would have been arbitrary. As to claims 38 and 42, as stated above it was obvious to use the same frequency band in the processors."

Applicants note that these claims are dependant on claims discussed above. Applicants do not consider these choices as obvious, because there are many circumstances where, for instance, the choice to use the same frequency bands in both processors is not the optimum, as in the embodiment described for use with a snare drum and a hi-hat. Also, the choices for different transducer types may be dependent on a variety of factors that include cost and differences in environment.

<u>ONO</u>

The invention of Ono is to add dynamic level control to a selected frequency band of a signal, in response to the expected circumstances that this frequency band will have significantly more unwanted noise than other frequency bands, but only sometimes. Dynamically reducing (by compressing or limiting) the entire signal when noise is determined to be above an acceptable threshold is common practice, but reduces the desired signal (e.g., someone talking to the listener) along with the noise (e.g., the rumble of passing traffic). Ono surmises that in these circumstances, the occasional offending rumble is mostly in a lower frequency band, while much of the frequency spectrum needed for understanding speech is in a higher frequency band. The

normal solution for this is to filter out the low band permanently, but Ono notices it is preferable to include this low band when it does NOT contain the rumble of passing traffic. His solution is to split the signal in two (high and low bands), and then dynamically reduce only the low band, leaving the high band un-altered. The system of Ono is simply to filter out unwanted sounds at the expense of fidelity, in a circumstance where fidelity is already highly limited (the user is hard-of-hearing), and where even limited fidelity is considered secondary to intelligibility. Normally, one would just filter out the noise, which leaves a sort of bad-telephone sound. Ono teaches to split the signal, and to use dynamic compression on the frequency band likely to have the worst noise.

Ono fails to teach or suggest the selection and adjustment of level in frequency bands independent of others in first and second signals as recited in the pending claims..

On page 7, the Office Action states: "...Therefore, Ono teaches decreasing one signal (low frequency noise) while increasing the other signal (high frequency sound)..."

Ono states (Col.2 lines 55-56,61-62):

"FIG. 2 shows frequency responses in the case in which the compensating means 5 is not employed."

and

"FIG. 3 shows frequency responses in the case in which the compensating means 5 is employed."

In other words, the Ono device would shift back and forth between the response of Figures 2 and 3, depending on a threshold set for the low frequency portion of the signal, as it comes out of the figure's block 3. Looking at the figures, one can see that the low frequencies are indeed reduced, but that the higher frequencies are not increased, but remain the same.

On page 7, the Office Action states: "Ono only uses one microphone to pick up the signal, which is a mix of wanted and unwanted components. Eastty uses a plurality of

microphones in its noise cancellation apparatus. The use of the apparatus of Eastty was advantageous because the noise microphone 2 generated a better estimate of the noise signal rather than the one microphone of Ono. Therefore, one of ordinary skill in the art would have been motivated to use the arrangement of Eastty. It would have been obvious to one of ordinary skill in the art at the time of invention to use a secondary microphone, per the teaching of Eastty, in the invention of Ono to improve its noise canceling capabilities."

Eastty uses two microphones because without two signals with some amount of 'correlated' (identical or very similar) signal, the method of Eastty will not function at all. It is not adaptable to any circumstance where only one microphone is available.

In the field of Ono, the use of a second microphone for use with some embodiment of Eastty is impossible. Eastty needs a time difference in order to function, and this time difference is created by the distance between the two microphones and the difference in that distance from the source. When the source is relatively far (a bus traveling down the street), the microphones would have to be very far away from each other (mic 2 at least several feet closer to the noise source); this is completely out of the question in the circumstance of a hearing aid, and there is no likelihood that anyone would be motivated to consider such an adaptation. Eastty also involves the use of delay, meaning everything would be heard late or echoed, an unacceptable situation for a user.

As noted above, adjustments of any frequency bands in any signal path of the system of Eastty are likely to UNDO the effectiveness of the adaptive adjustments by introducing phase differences, and therefore DEGRADE the performance of Eastty. Furthermore, Eastty's method specifically avoids filtering the primary signal content; Eastty uses two signal sources to *avoid* filtering the primary signal content. Therefore, as with Yamada, it would not be obvious to use Ono to improve or modify noise cancellation by Eastty. The techniques for noise cancellation of

Ono and Eastty are mutually exclusive.

Therefore, it would not be obvious to adapt the system of Ono for use with a second microphone in light of adapting the invention of Eastty.

On page 7, the Office Action states: "With the secondary microphone, the output signal could be sent directly to the branch with the low pass filter 3 (hereafter named the first branch)."

In the field of Ono, the only desired sound is that at the listener's ears (a hearing aid). Any second microphone in the signal path would cause psychoacoustic problems, because the listener would be hearing the world from 2 different places. Also, in the system of Ono, a second microphone will simply pick up the same randomized background noises as the first microphone, especially in the low frequency range, so their outputs would be the same. To do this, connecting a first microphone and first amp to be applied to the input of FIG 1 #3, and connecting a second microphone and second amp to the input of FIG 1 #4, would not provide any improvement, but does add cost, etc. Therefore, it would not be obvious to adapt the system of Ono for use with a second microphone.

In view of the amendments and remarks above, Applicants submit that features of the claims are neither disclosed nor suggested by Zoels, Yamada and the remaining cited references. Accordingly, reconsideration and withdrawal of the rejection of claims 1-4, 8-21, 24, 25, 28, 29 and 36-43 under 35 U.S.C. §§ 102(e) and 103(a) is respectfully requested.

CONCLUSION

For all the above reasons, the Applicant respectfully submits that this application is in condition for allowance. A Notice of Allowance is earnestly solicited.

The Examiner is invited to contact the undersigned at (202) 220-4255 to discuss any matter concerning this application. The Office is hereby authorized to charge any additional fees or credit any overpayments under 37 C.F.R. §1.16 or §1.17 to Deposit Account No. 11-0600.

Respectfully submitted,
KENYON & KENYON

Dated: APRIL 23, 2003

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